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GA-16/110 AND GA-16/220 MICROCOMPUTERS

PRODUCT DESCRIPTION

General Automation's new GA-16/110 and GA-16/220 offer a new standard of performance in LSI microcomputers. Full-fledged 16-bit computers in all respects, they outperform every other microcomputer on the market.

Their speed is significantly faster, their instruction repertoire is superior and their system features are more complete. They are totally compatible with the full array of General Automation software and I/O products. Still, they are directly competitive in the microcomputer price range.

The GA-16/110 is a complete computer with CPU, memory and I/O on a single board. The GA-16/220 adds a second CPU board to provide additional system features.

The GA-16/110 and GA-16/220 are ideal for all microcomputer applications requiring not only low price but also higher performance and more support than all other microcomputers.

FEATURES

Total compatibility - software and I/O compatible with GA-16/440, GA-16/330 and SPC-16.

Off-the-shelf software - 4 field-proven operating systems, 5 subsystems, 5 languages, plus extensive utilities and programming aids.

Off-the-shelf controllers - more than 100 field-proven I/O controllers for peripherals, process I/O and communications.

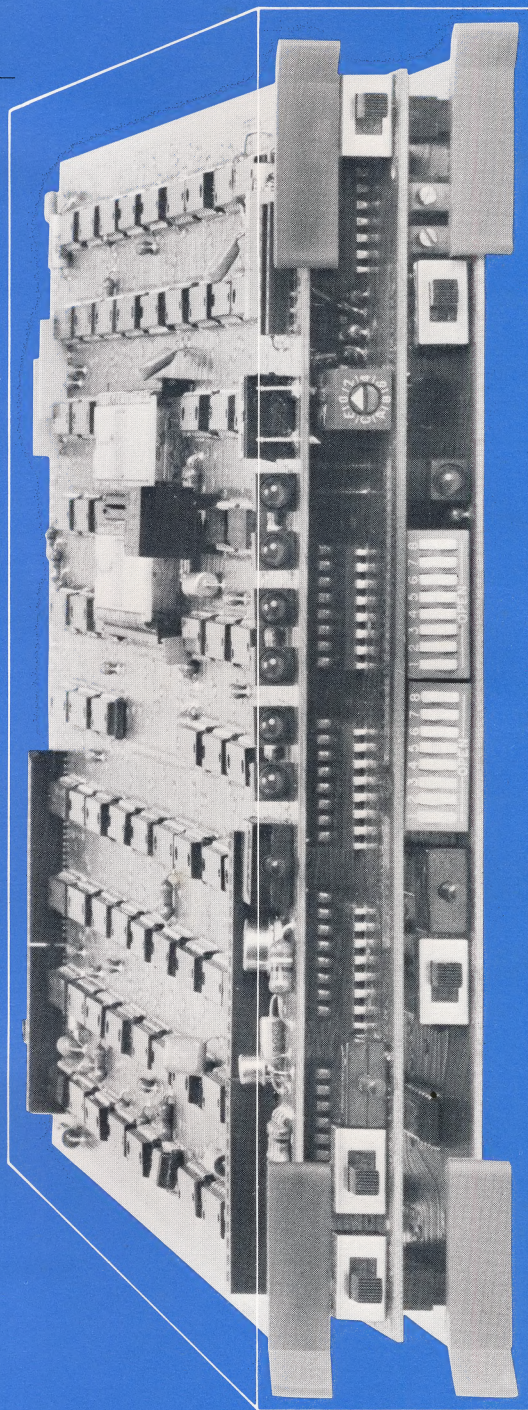
Memory parity and write protect - for operating integrity.

High performance -

- 16 general purpose registers
- Fast real-time context switching
- 3 I/O ports
- Interleaved DMA
- Hardware multiply/divide
- Vectored priority interrupts

OEM configuration versatility - a wide choice of hardware and software options to configure individual OEM systems.

Low price - minicomputer performance and maxicomputer software at microcomputer prices.



GENERAL AUTOMATION INC

SOFTWARE

The GA-16/110 and GA-16/220 are supported by the most advanced software tools in the business. No other microcomputer is in the same league. That is because GA's **microcomputer** software is field-proven **minicomputer** software, embodying big-machine features:

Re-entrant and recursive—Exceptional efficiency, using dynamic storage allocation and base relative addressing.

Device independent—Modular calling sequences for I/O devices and files.

Relocatable—Object programs, translated and linked, load and execute anywhere in memory.

Compatible languages and software—FORTRAN, Commercial FORTRAN and COBOL modules link with assembly language subroutines to form a single program.

Using the following source-compatible development and operating software the OEM can get his product to the market sooner. Programs take less memory and run faster. This translates directly into lower cost and better performance.

MORE LANGUAGES

CAP-16 Macro Assembler

COBOL—ANSI Standard X3.23-1974 Level One, with numerous extensions from Level Two

FORTRAN IV—ANSI Standard X3.9-1968 with extensions

Commercial FORTRAN—FORTRAN IV combined with elements of BASIC and COBOL

BASIC—single-user or multi-user

SYSTEM SUPPORT TOOLS

FSOS-16—Program generation on low cost systems

DBOS-16—Disk-based batch processing and program generation.

RTX-16—memory-resident, real-time priority scheduling of up to 255 separate programs

RTOS-16—disk-based, real-time, multiprogrammed foreground operations, background batch processing, automatic disk overlay and roll-out with dynamic memory allocation.

FMS—modular management of data bases

Overlay Manager—run-time management of disk overlays

Output Spooler—automatic disk buffering of low-speed peripherals

SORT—COBOL record sort on multi-level key fields

IOS—device-independent I/O drivers

Core Load Overlay Builder—links main programs and subroutines into relocatable or absolute object programs with check summing

Concordance—cross reference tables

Source Text Editor **Utilities**

Dynamic Debug **Diagnostics**

HARDWARE

The GA-16/110 and GA-16/220 are high performance microcomputers, typically outperforming other micros by a margin greater than 2-to-3 times. This is due to the combination of instruction set, micro-coding, CPU architecture and I/O versatility.

Instruction set performance—The microcomputer instruction set is an extension of the SPC-16 and a subset of the GA-16/440, both very powerful minicomputers. It provides 93 basic, micro-coded instructions with 2100 variants. It is rich in multi-function instructions like:

SARS/LARS; single instructions, which push/pop all registers and status in a fast micro-coded sequence for more efficient stack operations.

MPY/DIV; which perform fast 16-bit multiply/divide in hardware and micro-code rather than through shift/add/subtract subroutines of other micros.

CPU performance—Like GA-16/110 minicomputers, the GA-16/220 microcomputers are organized around 16 general-purpose 16-bit registers. Each register can be used as accumulator, context, index, or counter. Each register can execute any instruction. Six registers also operate as index registers. In addition there are two for base relative addressing and two for subroutine linking.



Compact GA16/220 with 32K bytes of RAM, battery back-up and I/O controllers.

This provides unmatched memory addressing power, with 11 address modes which access all words, bytes and individual bits in a full range of 128K bytes of memory.

For servicing interrupts, context switching between foreground and background registers provides a powerful means to enhance system throughput. Programs simply switch from one 8-register bank to the other. No other microcomputer provides this degree of versatility and processing power.

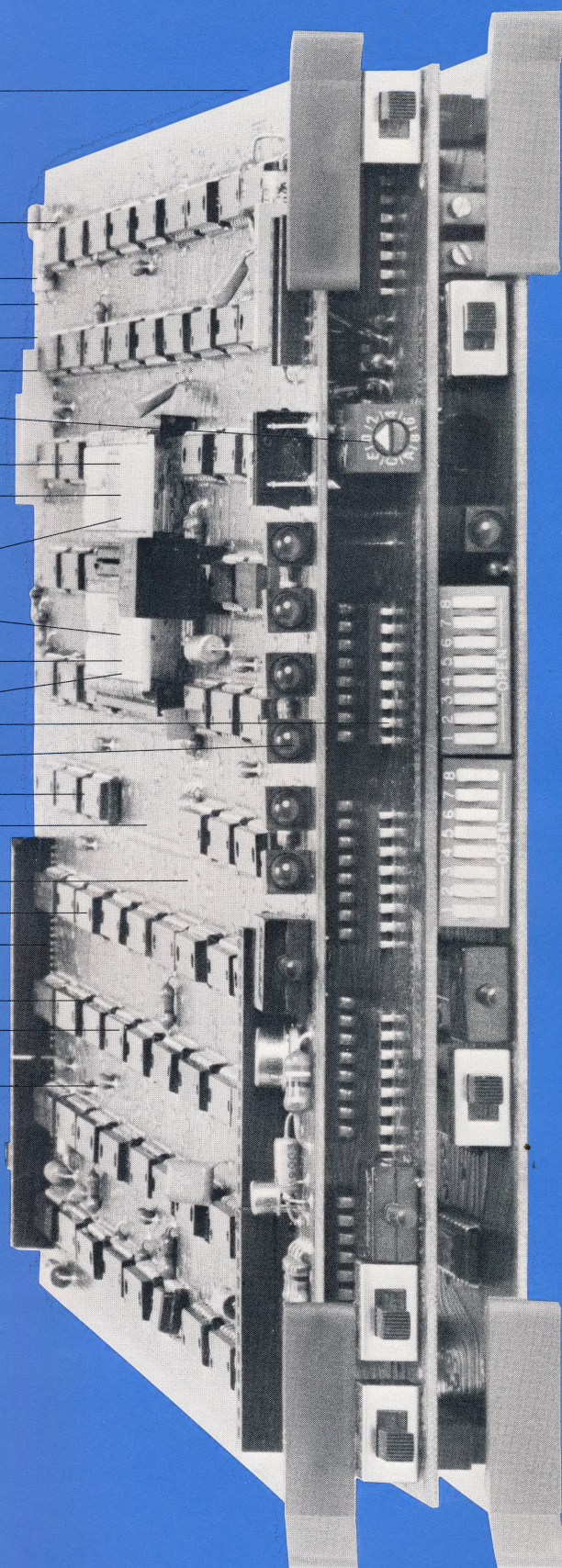
GA's microcomputers provide a unique Virtual Console. It provides a built-in microconsole for dedicated OEM installations plus a new versatility in interactive system control. There are provisions for autoloading from peripherals or downloading from a host computer.

I/O Performance — maximum throughput, all CPU, memory and I/O operations are parallel and asynchronous. The microcomputers run more than 100 I/O controllers for all types of peripherals, process control and communications.

The GA-16/110 and GA-16/110 with the microconsole are the best microcomputer buys on the market. Compare them.

For more details, ask for the 24-page brochure.

- More than 100 I/O controllers
- Vectored priority interrupts
- DMA
- Programmed I/O
- Serial I/O controller
- Autoload ROM
- Fully parallel 16-bit nMOS LSI CPU
- 16 General registers
- Dual register banks for fast context switching
- 64K and 32K direct addressability
- Bit, byte and word operations
- Hardware multiply/divide
- Virtual console ROM
- On board microconsole
- RTC
- PF/AR
- Operations monitor alarm
- System safe restart
- Battery back-up
- RAM/EPROM/PROM memory
- Byte parity
- Memory write protect



SPECIFICATIONS

ARCHITECTURE

Microprogrammed
All registers and buses 16-bit parallel
16 general purpose registers
Parallel binary two's complement
500 nsec microcycle
64K direct addressability
Single and double word addressing
Software and I/O compatible with GA-16
Series and SPC-16

TECHNOLOGY

Processor-LSI n-Channel MOS
Memory RAM-n MOS
PROM-bipolar
Four-layer PC Boards

SYSTEM FEATURES

Integral microconsole
System console interface
Foreground/background registers
Fast context switching
Hardware multiply/divide
Vectored priority interrupts
Real-time clock
Operation monitor alarm
Power failure/auto-restart
Cold start
Remote control lines
Auto-load PROM
Bit, byte, word instructions

REGISTERS

Programmable registers	16
Accumulators	16
Index registers	6
Base registers	2
Subroutine linkage	2

INSTRUCTIONS (Fourteen classes)

93 instructions
Memory reference
Memory reference indexed
Skip ± 256 locations on eight conditions
Register operate
Register operate and compare
Register operate literal
Register operate literal and compare
Register change
Shift (0-16 bits)
Control
Input/Output (addressing to 64 devices,
single-word instructions)

ADDRESSING (Eleven modes)

Direct
Direct, Indexed
Indirect
Indirect, Indexed
Program Relative
Program Relative, Indirect
Base Relative
Base Relative, Indexed
Base Relative, Indirect
Base Relative, Indirect, Indexed
Literal

SEMICONDUCTOR MEMORY

Asynchronous tri-state memory bus

Plug-in dynamic RAM

4K and 8K $\times$ 16-bit/18-bit/22-bit
Byte parity and error correction
Write protect
Transparent refresh

Piggyback EPROM

3K $\times$ 16-bit EPROM + 1K word RAM

Piggyback RAM

1K and 2K $\times$ 16-bit static RAM + 64 word
autoload PROM

INTERRUPTS

Non-inhibitable

Powerfail
Auto Restart
TTY BREAK
Memory parity and write protect
Interrupt program time out
Non-implemented Op code

I/O

Real Time Clock
TTY ready
Operator interrupt
External I/O (unlimited number)

INPUT/OUTPUT

Programmed I/O Bus (110 and 220)

Parallel lines for address, data in, data out
and control
Vectored Priority chain
GA software supports 64 devices
120K word/sec transfer rate
Transfers - To/from memory
- To/from any of 16 registers
Compatible with all GA-16 and SPC-16
programmed I/O controllers

DMA Channel (220 only)

Parallel lines for address, data in, data out
and control
Priority chain for multidevices
Interleaved with CPU
2.0M bytes/sec transfer rate
Compatible with all GA-16 and SPC-16
DMA controllers

DMT Port (110 and 220)

Allows placement of two DMT controllers
directly on tri-state memory bus
Interleaved with CPU and DMA
4.0M words/sec transfer rate

DIMENSIONS

All plug-in boards

19.7cm $\times$ 27.9cm
7 $\frac{3}{4}$ " $\times$ 11" - 140 pin connector

Compact, Jumbo and I/O Expansion Chassis

22.2cm $\times$ 48.3cm $\times$ 38.9cm
8.75" $\times$ 19" $\times$ 15.3"

Jumbo System Power Supply

26.8cm $\times$ 48.3cm $\times$ 14.6cm
10.57" $\times$ 19" $\times$ 5.75"

DC POWER

Compact PS

115VAC, 47-63Hz
18A at +5V; 3A at +15V; 2A at -15V
Requires transformer for other primary
voltages

Jumbo PS

115 or 230VAC, 47-63Hz
30A at +5V; 5A at +15V; 5A at -15V

Battery Backup PS

1.5 amp hour battery, plugs into 115VAC
or 220VAC, 47-63Hz
Provides ± 5 VDC and +12VDC to memory
Connector for large external battery
Memory retention:
Normal - Indefinite
Loss of AC - Approximately one hour
hour with 16K

ENVIRONMENT

Temperature -10°C - 50°C
Humidity - Non-condensing

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